

## **Appendix C**

### **Materials Usage Agreements/Certifications**

## **LIST OF MATERIAL USAGE AGREEMENTS/ CERTIFICATIONS**

1. 7050-T7451/T7452 Parts in USS, VC, PAS, and ROEU of Alpha Magnetic Spectrometer- 02 (AMS-02), Usage Agreement AG 577.....C-3
2. Al 5083-H111 and 5083-H321 Parts Used in Helium Tank of Alpha Magnetic Spectrometer- 02 (AMS-02), Usage Agreement AG 594.....C-9
3. JSC Materials and Fracture Control Certification, REF: MATL-09-036, Alpha Magnetic Spectrometer (AMS-02) Data Interface hardware .....C-13

ISS MATERIALS USAGE AGREEMENT			USAGE AGREEMENT NO.		REV.	PAGE 1 OF 2
			AG 577			
TITLE: 7050-T7451/T7452 Parts in USS, VC, PAS, and ROEU of Alpha Magnetic Spectrometer- 02 (AMS-02)			CATEGORY:	EFFECTIVITY: 2 STS-134		
TYPE OF DEVIATION:		REQUIREMENT DEVIATED:				
<input checked="" type="checkbox"/> MATERIAL <input type="checkbox"/> EQUIPMENT (NO. PER VEHICLE: 1)		<input type="checkbox"/> FLAMMABILITY <input type="checkbox"/> TVS <input checked="" type="checkbox"/> SCC <input type="checkbox"/> OFFGASSING <input type="checkbox"/> O <sub>2</sub> COMPATIBILITY <input type="checkbox"/> OTHER				
EQUIPMENT		PART NUMBER			MANUFACTURER	
		See Table I of Attachment 1				
MATERIAL		TRADE NAME		SPECIFICATION	MANUFACTURER	
See Table I of Attachment 1				See Table I of Attachment 1		
THICK (in.)	WEIGHT (lbs.)	AREA (in <sup>2</sup> )	LOCATION	ENVIRONMENT		
			<input type="checkbox"/> HABITABLE <input checked="" type="checkbox"/> NONHABITABLE	TEMPERATURE (°F)	PRESS (PSIA)	MEDIA
				-58 F to +140 F	Space Vacuum	Vacuum
APPLICATION (use second sheet if required) The AMS-02 is an ISS experiment payload, which will be attached to ISS S3 Zenith Inboard Payload Attachment System (PAS). It uses a large cryogenic superconducting magnet and several high energy particle detector systems to collect cosmic ray data. Its major subsystems include the Unique Support Structure (USS)-02, Vacuum Case (VC), Synchrotron Radiation Detector (SRD), Transition Radiation Detector (TRD), Anti-Coincidence Counter (ACC), Time of Flight (TOF) Detector, Silicon Tracker, Cryogenic Superconducting Magnet, Ring Imaging Cherenkov Counter (RICH), and Electromagnetic Calorimeter (ECAL). The AMS-02 payload configuration for launch, landing, and on-orbit is shown in Figure 1, Attachment 1. The USS-02 is the primary structural element of the AMS-02 payload. The USS-02 consists of five subassemblies- the upper USS-02, VC, lower USS-02, Payload Attach System (PAS), and Keel. An explored view of the USS-02 is shown in Figure 2, Attachment 1. The VC supports the Cryomagnet cold mass by sixteen (Continued on next page)						
RATIONALE (use second sheet if required) The rationale for the use of the Al alloy 7050-T7451 parts in the AMS-02 payload is as follows: - Aluminum alloy 7050-T7451 is stronger than aluminum alloy 7075-T7351 (Table I material for SCC) and has design allowables for thick plate stocks (greater than 4 inches) in Metallic Materials Properties Development and Standardization (MMPDS) Handbook. - The sustained tensile stresses of these 7050-T7451 parts are less than the SCC threshold stress for 7050-T7451 Al alloy. - These 7050-T7451 parts have adequate corrosion protection surface finish and are protected from long exposure to corrosive environments. - These 7050-T7451 parts are used in benign use environment (space vacuum).						
APPROVALS						
ORIGINATOR/ORGANIZATION <i>Chia-hsiung Fan/what</i>	DATE 9/25/09	JSC MATERIALS AND PROCESSES TECHNOLOGY BRANCH <i>Julie A. Henkener</i>			DATE 9-25-09	
PROJECT MANAGER <i>Carl Lauritsen</i>	DATE 28 Sep 2009	PROGRAM MANAGER			DATE	

JSC Form 1466 (Rev June 93)

NASA-JSC

*Carl Lauritsen 09-28-2009*

ISS MATERIALS USAGE AGREEMENT		USAGE AGREEMENT NO.	REV.	PAGE 2 OF 2
		AG577		
TITLE: Alpha Magnetic Spectrometer 02 (AMS-02)		CATEGORY: 2	EFFECTIVITY: STS-134	
APPLICATION (Cont.)  composite straps and serves as a vacuum jacket for the superfluid helium tank. The VC attaches to the USS-02 via eight interface plates and two clevis plates. The 7050-T7451 Al alloy is used in several structural components of the USS, VC, PAS, and Remotely Operated Electrical Umbilical (ROEU) provided by NASA Johnson Space Center for AMS-02. A list of 7050-T7451 parts provided by NASA JSC is shown in Table I, Attachment 1. The 7050-T7451 (or its equivalent 7050-T73651 designation) Al alloy is a Table II material with moderate resistance to SCC per MSFC-STD-3029, Guidelines for the Selection of Metallic Materials for Stress Corrosion Resistance in Sodium Chloride Environments. This MUA provides the acceptance rationale for the use of these 7050-T7451 parts in the AMS-02 payload.				

## Attachment 1

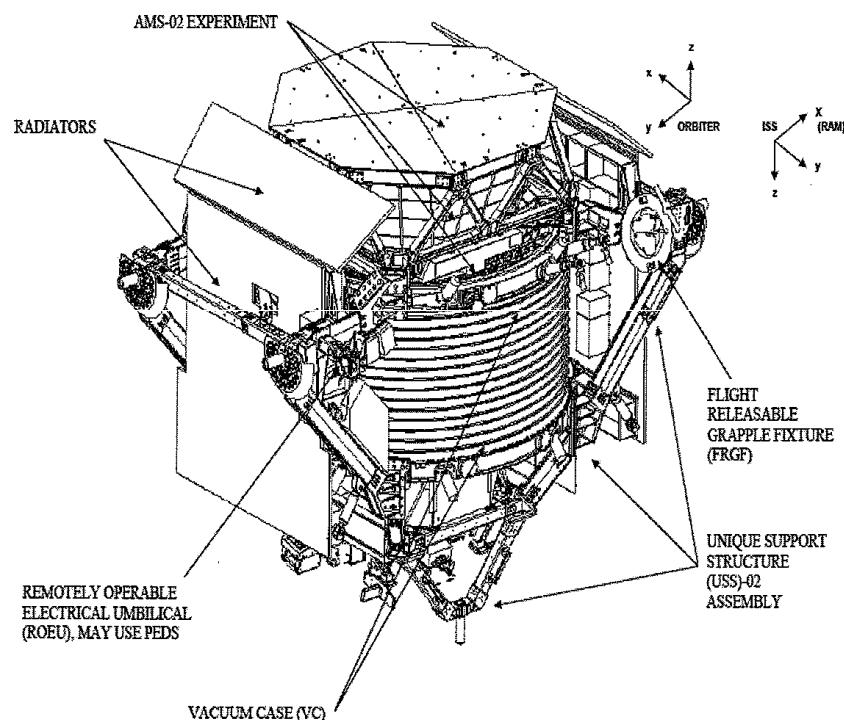


Figure 1 : AMS-02 Payload Configuration- Launch, Landing, and On-Orbit

**Attachment 1 (Cont.)**

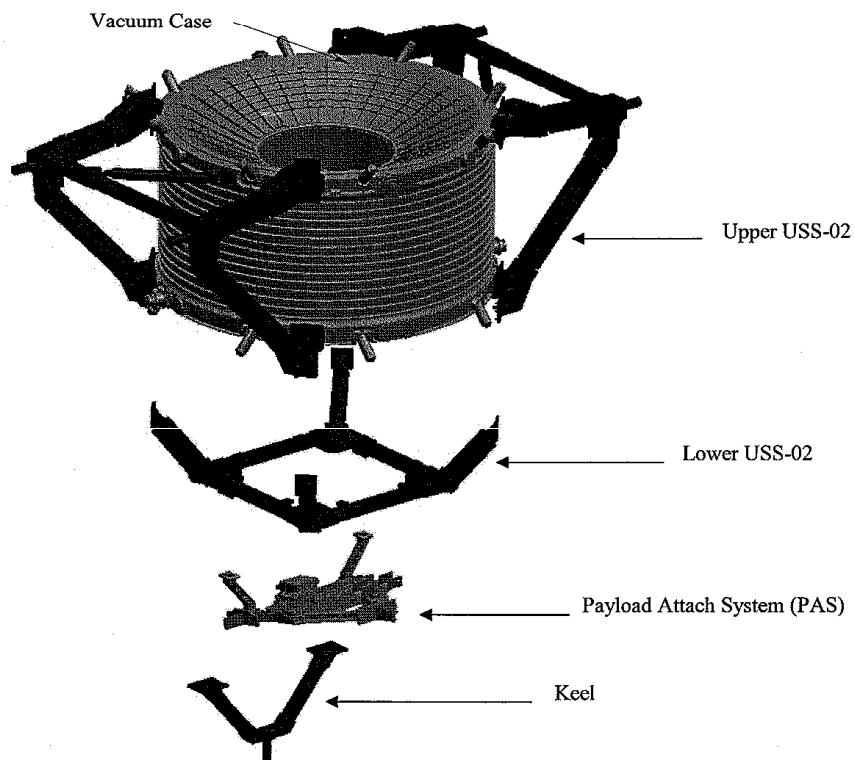


Figure 2: An exploded view of USS-02 showing its subassemblies

**Attachment 1 (Cont.)**  
**Table I: List of 7050-T7451/T7452 Parts Provided by JSC for AMS-02 Payload**

Item No.	Subsystem	Part Name	Part Number	Material	Specification	Dimensions, Inches (LxWxH)	Engineering Drawing	Yield Stress, MPa (ksi)	SCC Threshold Stress (ksi)	Sustained Tensile Stress (ksi)
1	VC	Outer Cylinder, Vacuum Case Assy	SDG39135779	Al 7050-T7452	Al 7050-T7452	Alms 4108 OD=109" ID=105" L=53"	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135779_A_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135779_A_0.PDF</a>	S-basis 52 in ST or Radial dir.	35 in ST dir.	6.9
2	VC	Lower Support Ring, Vacuum Case Assy	SDG39135785	Al 7050-T7452	Al 7050-T7452	Alms 4108 OD=110" ID=98" L=62.5"	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135785_NC_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135785_NC_0.PDF</a>	S-basis 52 in ST or Radial dir.	35 in ST dir.	22.0
3	VC	Upper Support Ring, Vacuum Case Assy	SDG39135784	Al 7050-T7452	Al 7050-T7452	Alms 4108 OD=110" ID=98" L=63.5"	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135784_NC_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135784_NC_0.PDF</a>	S-basis 52 in ST or Radial dir.	35 in ST dir.	20.6
4	VC	Interface Plate Assy, Upper VCA	SDG39135788	Al 7050-T7451	Alms 4050	10.5 x 6.0 x 1.8	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135788_A_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135788_A_0.PDF</a>	A-basis 59 in ST dir.	35 in ST dir.	19.7
5	VC	Interface Plate Assy, Lower VCA	SDG39135789	Al 7050-T7451	Alms 4050	11.0 x 6.0 x 1.8	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135789_A_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135789_A_0.PDF</a>	A-basis 59 in ST dir.	35 in ST dir.	13.3
6	USS	Interface Joint Assy, Upper VC, Upper USS-02 Assy	SDG39135727	Al 7050-T7451	BMS 7-322C	21.1 x 15.7 x 8.9	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135727_C_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135727_C_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	5.6
7	USS	Stil Joint Assy, Upper USS-02 Assy	SDG39135730	Al 7050-T7451	BMS 7-322C	16.5 x 15.7 x 6.5	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135730_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135730_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	31.0
8	USS	Bridge Beam Elbow, Lower Trunnion	SDG39135734	Al 7050-T7451	BMS 7-322C	14.2 x 10.0 x 6.0	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135734_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135734_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	26.7
9	USS	Interface Joint Assy, Lower VC, Lower USS-02 Assy	SDG39135737	Al 7050-T7451	BMS 7-322C	18.4 x 17.9 x 7.6	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135737_D_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135737_D_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	5.9
10	USS	Bracket, Still, Upper USS-02 Assy	SDG39135738	Al 7050-T7451	BMS 7-322C	9.0 x 5.8 x 5.8	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135738_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135738_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	8.8
11	USS	Diagonal Bracket, Still, Upper USS-02 Assy	SDG39135740	Al 7050-T7451	BMS 7-322C	23.1 x 10.0 x 5.8	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135740_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135740_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	25.0
12	USS	Confinerbody Box Joint Keel Interface Assy, Lower USS-02 Assy	SDG39135759	Al 7050-T7451	BMS 7-322C	14.9 x 14.9 x 3.0	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135759_D_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135759_D_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	21.4
13	USS	Centerbody Box Joint Assy, Lower USS-02 Assy	SDG39135760	Al 7050-T7451	BMS 7-322C	14.9 x 14.9 x 3.0	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135760_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135760_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	8.8
14	USS	Joint Assy, Lower USS to Upper USS, Lower USS-02 Assy	SDG39135762	Al 7050-T7451	BMS 7-322C	11.9 x 7.5 x 1.2	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135762_A_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135762_A_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	8.8
15	USS	RICH Mounting Bracket, Lower USS-02 Assy	SDG39135763	Al 7050-T7451	BMS 7-322C	6.4 x 4.1 x 10	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135763_NC_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135763_NC_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	10.9
16	USS	PAS Rich Block Assy, Keel Assy, Lower USS-02 Assy	SDG39135766	Al 7050-T7451	BMS 7-322C	7.5 x 6.9 x 5.3	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135766_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135766_B_0.PDF</a>	Mn. 57 in ST dir.	35 in ST dir.	0.6
17	USS	Lower Angle Beam Flange, Lower USS-02 Assy	SDG39135767	Al 7050-T7451	BMS 7-322C	7.5 x 7.4 x 6.4	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135767_A_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135767_A_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	27.5
18	USS	Keel Angle Joint, Keel Assy	SDG39135769	Al 7050-T7451	BMS 7-322C	11.6 x 8.6 x 1.8	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135769_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135769_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	18.4
19	USS	Keel Block Assy, Keel Assy	SDG39135770	Al 7050-T7451	BMS 7-322C	20.7 x 7.0 x 1.0	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135770_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135770_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	1.8
20	PAS	PAS Platform Assy, PAS Base Assy	SDG39135817	Al 7050-T7481	BMS 7-322C	44.5 x 46.4 x 2.8	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135817_A_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135817_A_0.PDF</a>	Mn. 57 in ST dir.	35 in ST dir.	0.6
21	PAS	Bridge Assy, PAS Bridge Assy	SDG39135837	Al 7050-T7481	BMS 7-322C	37.6 x 3.6 x 2.1	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135837_B_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135837_B_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	21.3
22	PAS	PAS Verier Bracket	SDG39135813	Al 7050-T7451	BMS 7-322C	16.5 x 10.7 x 7.9	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135813_NC_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135813_NC_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	26.2
23	PAS	PAS Att Tracket	SDG39135814	Al 7050-T7451	BMS 7-322C	14.6 x 12.2 x 7.5	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135814_NC_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135814_NC_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	23.0
24	PAS	PAS Guide Pifas	SDG39135818	Al 7050-T7451	BMS 7-322C	14.0 x 3.8 x 1.0	<a href="https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135818_NC_0.PDF">https://edcc.jsc.nasa.gov/databases/edspublicrepository/39/S_DG39135818_NC_0.PDF</a>	Mn. 56 in ST dir.	35 in ST dir.	1.7

**Attachment 1 (Cont.)**  
**Table I: List of 7050-T7451/T7452 Parts Provided by JSC for AMS02 Payload**

25	ROEU	Civilis, ROEU Assembly	SDG39137678	AL 7050-T7451	BMS 7-323C	12.0 x 8.6 x 4.6	<a href="https://edc.csc.nasa.gov/datasets/repository39/S">https://edc.csc.nasa.gov/datasets/repository39/S</a>	Min. 57 in ST dir	35 in ST dir	4.4
26	ROEU	FDA Mounting Bracket, ROEU Assembly	SDG39137678	AL 7050-T7451	BMS 7-323C	25.6 x 7.8 x 4.6	<a href="https://edc.csc.nasa.gov/datasets/repository39/S">https://edc.csc.nasa.gov/datasets/repository39/S</a>	DC39137678_A_0.PDF		
27	ROEU	FDA Harness Bracket, ROEU Assembly	SDG39138685	AL 7050-T7451	BMS 7-323C	8.8 x 7.5 x 1.0	<a href="https://edc.csc.nasa.gov/datasets/repository39/S">https://edc.csc.nasa.gov/datasets/repository39/S</a>	DC39138685_A_0.PDF		
28	USS	FRGf Bracket	SDG39138681	AL 7050-T7451	BMS 7-323C	12.0 x 10.7 x 5.5	<a href="https://edc.csc.nasa.gov/datasets/repository39/S">https://edc.csc.nasa.gov/datasets/repository39/S</a>	DC39138681_A_0.PDF		
29	USS	Scuff Plate	SDG39135887	AL 7050-T7451	BMS 7-323C	26.0 x 18.3 x 3.8	<a href="https://edc.csc.nasa.gov/datasets/repository39/S">https://edc.csc.nasa.gov/datasets/repository39/S</a>	DC39135887_A_0.PDF		
<b>NOTES:</b>										
* The tensile yield stress values were obtained from Table 3.7.4(d) in MPDS-03 for 7050-T7451 plates and Table 3.7.4(e) in MPDS-03 for 7050-T7452 rolled ring forging.										
* The SCC threshold stress values were obtained from Table 3.1.2.3.1(b) in MPDS-03 for 7050-T7451 plates per AMS050 and Table 3.1.2.3.1(e) in MPDS-03 for 7050-T7452 rolled ring forging per AMS 4108.										
ST: Short Transverse direction										
(1) Boeing material specification BMS 7-323C, High Strength Fatigue Tolerant, Stress Corrosion Resistant 7050 Aluminum Alloy Plate, meets the technical requirements of AMS450.										
(2) The manufacturing processes used for these parts were not susceptible to generating residual stresses.										
(3) These parts have all been checked by quality personnel to ensure that the part meets the tolerances on the drawings; thus, minimizing stress due to misalignment during assembly. During assembly, the procedures ensure that the parts are not forced to fit and fastener are not over-torqued.										

ISS MATERIALS USAGE AGREEMENT			USAGE AGREEMENT NO.		REV.	PAGE 1 OF 2
			AG 594			
TITLE: Al 5083-H111 and 5083-H321 Parts Used in Helium Tank of Alpha Magnetic Spectrometer- 02 (AMS-02)			CATEGORY: 2	EFFECTIVITY: STS-134		
TYPE OF DEVIATION:		REQUIREMENT DEVIATED:				
<input checked="" type="checkbox"/> MATERIAL <input checked="" type="checkbox"/> EQUIPMENT (NO. PER VEHICLE: 1)		<input type="checkbox"/> FLAMMABILITY <input type="checkbox"/> TVS <input checked="" type="checkbox"/> SCC <input type="checkbox"/> OFFGASSING <input type="checkbox"/> O <sub>2</sub> COMPATIBILITY <input checked="" type="checkbox"/> OTHER Corrosion				
EQUIPMENT		PART NUMBER			MANUFACTURER	
Helium Tank		See Table I of Attachment 1			Space Cryomagnetics	
MATERIAL		TRADE NAME		SPECIFICATION	MANUFACTURER	
See Table I of Attachment 1						
THICK (in.)	WEIGHT (lbs.)	AREA (in <sup>2</sup> )	LOCATION	ENVIRONMENT		
			<input type="checkbox"/> HABITABLE <input checked="" type="checkbox"/> NONHABITABLE	TEMPERATURE (°F)	PRESS (PSIA)	MEDIA
				-58 F to +140 F	Space Vacuum	Vacuum
<b>APPLICATION</b> (use second sheet if required)						
<p>The AMS-02 is an ISS experiment payload, which will be attached to ISS S3 Zenith Inboard Payload Attachment System (PAS). It uses a large cryogenic superconducting magnet and several high energy particle detector systems to collect cosmic ray data. Its major subsystems include the Unique Support Structure (USS)-02, Vacuum Case (VC), Synchrotron Radiation Detector (SRD), Transition Radiation Detector (TRD), Anti-Coincidence Counter (ACC), Time of Flight (TOF) Detector, Silicon Tracker, Cryogenic Superconducting Magnet, Ring Imaging Cherenkov Counter (RICH), and Electromagnetic Calorimeter (ECAL). The superconducting magnet and helium tank are enclosed in the vacuum sealed VC as shown in Figure 1, Attachment 1. The magnet coils are cooled by conduction to the helium tank, which is a fully welded toroidal Al 5083 pressure vessel.</p>						
(Continued on next page)						
<b>RATIONALE</b> (use second sheet if required)						
<p>Stress-Corrosion Cracking (SCC) is a failure phenomenon that occurs in SCC sensitive materials when they are subjected to sustained tensile stress in the presence of a corrosive environment. SCC failure will not occur if the SCC sensitive materials are not exposed to a corrosive environment. After fabrication, the welded Al 5083 helium tank is not exposed to a corrosive environment because it is installed in the VC, which is either under vacuum of 1.0 x 10E(-6) torr or pressurized to 15.4 psi with dry nitrogen or argon gas. The liquid helium in the helium tank is kept at 1.8 degrees Kevin. No moisture is present in the liquid helium at 1.8 degrees Kevin. The liquid helium is an inert environment for bare Al 5083-H111 and Al 5083-H321. No corrosion and SCC problem is expected for these Al 5083-H111 and Al 5083-H321 parts because the helium tank is not exposed to a corrosive environment after its fabrication through its flight use. The use of bare Al 5083-H111 and Al 5083-H321 parts in the helium tank is acceptable for corrosion and SCC.</p>						
<b>APPROVALS</b>						
ORIGINATOR/ORGANIZATION <i>Chia-Chang An</i>	10/30/09	DATE 10/30/09	JSC MATERIALS AND PROCESSES TECHNOLOGY BRANCH <i>Julie A. Henkener</i>	DATE 11-3-09		
PROJECT MANAGER <i>C.A.</i>		DATE 30 Oct 2009	PROGRAM MANAGER	DATE		

<b>ISS MATERIALS USAGE AGREEMENT</b>		<b>USAGE AGREEMENT NO.</b>	<b>REV.</b>	<b>PAGE 2 OF 2</b>
		AG594		
<b>TITLE:</b> Al 5083-H111 and 5083-H321 Parts Used in Helium Tank of Alpha Magnetic Spectrometer- 02 (AMS-02)		<b>CATEGORY:</b> 2	<b>EFFECTIVITY:</b> STS-134	
<b>APPLICATION (Cont.)</b>				
<p>The main structural components of the helium tank are made of Al 5083-H111 and Al 5083-H321. Al 5083-H111 is Table I material and Al 5083-H321 is Table II material for Stress Corrosion Cracking (SCC) per MSFC-STD-3029, Guidelines for the Selection of Metallic Materials for Stress Corrosion Resistance in Sodium Chloride Environments. A list of Al 5083-H111 and Al 5083-H321 parts used in the helium tank is shown in Table I, Attachment 1. These Al 5083-H111 and Al 5083-H321 parts have no corrosion protective surface finish. This MUA provides the acceptance rationale for the use of these bare Al 5083-H111 and Al 5083-H321 parts in the helium tank.</p>				

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ATTACHMENT 1

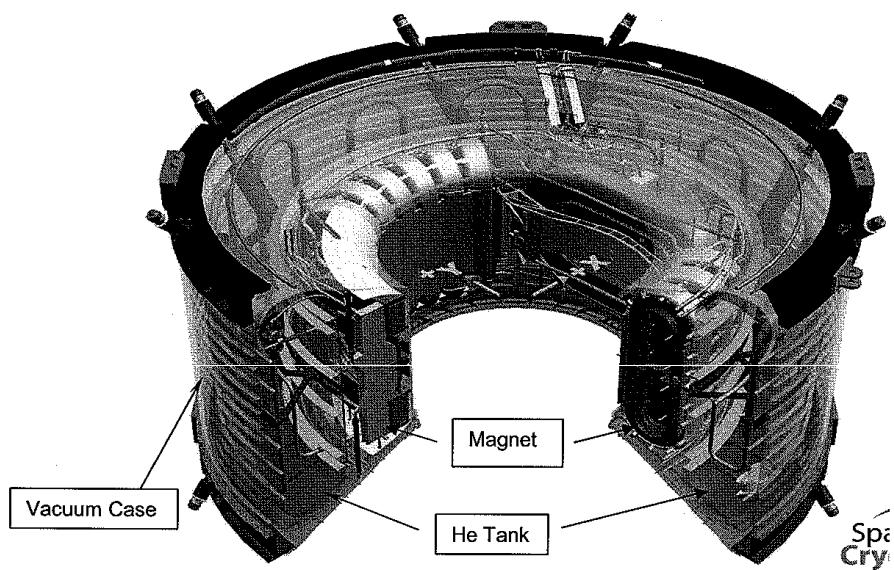
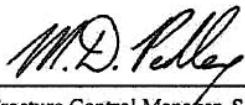
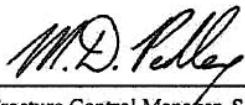
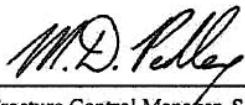


Figure 1: Helium Tank and Magnet Shown in Cut-away View of Vacuum Case

## ATTACHMENT 1 (Cont.)

**Table I: List of AL 5083-H111 and AL 5083-H321 Parts Used in Helium Tank**

Item No.	Subsystem	Part Name	Part Number	Material	Corrosion Protective Finish	Dimensions, inches (LxWxH)
1	Helium Tank	Inner Central Ring	SCD0905-01	AL 5083-H111	None	OD= 1976 mm, ID=1922 mm, H=74 mm
2	Helium Tank	Outer Central Ring	SCD0905-01	AL 5083-H111	None	OD= 2580 mm, ID=2520 mm, H=66 mm
3	Helium Tank	Thro Tube	SCD0902-01	AL 5083-H321	None	OD= 113 mm, ID=102 mm, H=438 mm
4	Helium Tank	Thro Tube	SCD0903-01	AL 5083-H321	None	OD= 113 mm, ID=102 mm, H=420 mm
5	Helium Tank	Top Inner Ring	SCD0905-04	AL 5083-H321	None	OD= 2058 mm, ID=1922 mm, H=395 mm
6	Helium Tank	Bottom Inner Ring	SCD0905-05	AL 5083-H321	None	OD= 2058 mm, ID=1922 mm, H=435 mm
7	Helium Tank	Top Outer Ring	SCD0905-02	AL 5083-H321	None	OD= 2580 mm, ID=2436 mm, H=399 mm
8	Helium Tank	Bottom Outer Ring	SCD0905-03	AL 5083-H321	None	OD= 2580 mm, ID=2436 mm, H=439 mm
9	Helium Tank	Bottom End Dish	SCD0905-06	AL 5083-H321	None	OD= 2580 mm, ID=1922 mm, H=140 mm
10	Helium Tank	Top End Dish	SCD0905-07	AL 5083-H321	None	OD= 2580 mm, ID=1922 mm, H=140 mm
11	Helium Tank	Porous Plug	SCD0905-21	AL 5083-H321	None	126 mm x 131mm x 93 mm
12	Helium Tank	Burst Disc	SCD0905-10	AL 5083-H321	None	OD= 112 mm, ID=80 mm, L=43.6 mm
13	Helium Tank	Central Plate (Spoke)	SCD0905-01	AL 5083-H321	None	644 mm L, 20 mm x 20 mm I-beam, 3mm web thickness, 2 mm flange thickness
14	Helium Tank	Instrument Cable Support Bar	SCD0905-05	AL 5083-H321	None	244 mm x 25 mm x 3 mm

<b>JSC MATERIALS AND FRACTURE CONTROL CERTIFICATION</b>																	
PROJECT/SUBSYSTEM MANAGER: T. Martin/EA321	REF: MATL - 09 - 036	p.1 of 4															
HARDWARE NAME: Alpha Magnetic Spectrometer (AMS-02) Data Interface Hardware	PART NUMBER: See Attachment 2																
<b>APPLICABLE REQUIREMENTS:</b> <i>Materials Requirements:</i> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> NSTS 1700.7B, Safety Policy and Requirements for Payloads Using the Space Transportation System</li> <li><input checked="" type="checkbox"/> SE-R-0006D, Space Shuttle System Requirements for Materials and Processes</li> <li><input checked="" type="checkbox"/> SSP 30233G, Space Station Requirements for Materials and Processes</li> <li><input checked="" type="checkbox"/> JSC 27301E, Materials Control Plan for JSC Flight Hardware</li> <li><input checked="" type="checkbox"/> JSC 49774A, Standard Manned Spacecraft Requirements for Materials and Processes</li> <li><input type="checkbox"/> Other:</li> </ul> <i>Fracture Control Requirements:</i> <ul style="list-style-type: none"> <li><input type="checkbox"/> NASA-STD-5003, Fracture Control Requirements for Payloads Using the Space Shuttle</li> <li><input type="checkbox"/> SSP 30558C, Fracture Control Requirements for Space Station</li> <li><input type="checkbox"/> SSP 52005B, ISS Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures</li> </ul>																	
<b>SPECIFIC ASSESSMENTS:</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;"><input checked="" type="checkbox"/> Flammability</td> <td style="width: 33%;"><input checked="" type="checkbox"/> Age Life</td> <td style="width: 33%;"><input type="checkbox"/> Other:</td> </tr> <tr> <td><input checked="" type="checkbox"/> Toxicity</td> <td><input type="checkbox"/> Atomic Oxygen/Ultraviolet</td> <td></td> </tr> <tr> <td><input checked="" type="checkbox"/> Stress Corrosion Cracking</td> <td><input type="checkbox"/> Thermal Vacuum Stability</td> <td></td> </tr> <tr> <td><input checked="" type="checkbox"/> General Corrosion</td> <td><input type="checkbox"/> Fluid Compatibility:</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Fracture Control</td> <td><input checked="" type="checkbox"/> Not Applicable; Concurrence: M.S.</td> <td><input checked="" type="checkbox"/> Microbiological Resistance</td> </tr> </table>			<input checked="" type="checkbox"/> Flammability	<input checked="" type="checkbox"/> Age Life	<input type="checkbox"/> Other:	<input checked="" type="checkbox"/> Toxicity	<input type="checkbox"/> Atomic Oxygen/Ultraviolet		<input checked="" type="checkbox"/> Stress Corrosion Cracking	<input type="checkbox"/> Thermal Vacuum Stability		<input checked="" type="checkbox"/> General Corrosion	<input type="checkbox"/> Fluid Compatibility:		<input type="checkbox"/> Fracture Control	<input checked="" type="checkbox"/> Not Applicable; Concurrence: M.S.	<input checked="" type="checkbox"/> Microbiological Resistance
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<b>LOCATION:</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;"><input checked="" type="checkbox"/> Orbiter Crew Cabin</td> <td style="width: 33%;"><input checked="" type="checkbox"/> Spacehab</td> <td style="width: 33%;"><input checked="" type="checkbox"/> ATV</td> <td style="width: 33%;"><input checked="" type="checkbox"/> HTV</td> </tr> <tr> <td><input type="checkbox"/> Orbiter Payload Bay</td> <td><input checked="" type="checkbox"/> MPLM</td> <td><input checked="" type="checkbox"/> Space Station:</td> <td><input checked="" type="checkbox"/> Internal</td> </tr> <tr> <td><input checked="" type="checkbox"/> Progress</td> <td><input checked="" type="checkbox"/> Soyuz</td> <td><input type="checkbox"/> Other:</td> <td><input type="checkbox"/> External</td> </tr> </table>			<input checked="" type="checkbox"/> Orbiter Crew Cabin	<input checked="" type="checkbox"/> Spacehab	<input checked="" type="checkbox"/> ATV	<input checked="" type="checkbox"/> HTV	<input type="checkbox"/> Orbiter Payload Bay	<input checked="" type="checkbox"/> MPLM	<input checked="" type="checkbox"/> Space Station:	<input checked="" type="checkbox"/> Internal	<input checked="" type="checkbox"/> Progress	<input checked="" type="checkbox"/> Soyuz	<input type="checkbox"/> Other:	<input type="checkbox"/> External			
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<b>MATERIALS USAGE AGREEMENTS (MUAs):</b> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> No MUAs</li> <li><input type="checkbox"/> MUA Number(s):</li> </ul> <p>Deviation:</p>																	
<b>LIMITATIONS:</b> <input checked="" type="checkbox"/> No Limitations <ul style="list-style-type: none"> <li><input type="checkbox"/> Materials:</li> <li><input type="checkbox"/> Fracture Control:</li> </ul>																	
This JSC Materials and Fracture Control Certification is consistent with existing Materials or Fracture Control Reciprocal Agreements.																	
<div style="text-align: center;"> <b>APPROVALS</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">             Fracture Control Manager, S. Forth         </td> <td style="width: 33%; text-align: center;">           3/25/09            Date         </td> <td style="width: 33%; text-align: center;">             GFE Materials Control Manager, M. Pedley         </td> </tr> </table> </div>			 Fracture Control Manager, S. Forth	3/25/09 Date	 GFE Materials Control Manager, M. Pedley												
 Fracture Control Manager, S. Forth	3/25/09 Date	 GFE Materials Control Manager, M. Pedley															

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## ATTACHMENT 1

### Hardware Acceptance Summary Report for Materials

The following data interface hardware will be used in the crew compartment during various stages of data transmission from the AMS-02 payload in the Shuttle Cargo Bay to the T0 umbilical and the Next Generation Laptop System (NGLS):

1. AMS-02 RS422 T-0/PDIP Cable Assembly (SED39136112-302)
2. DDRS-02 Assembly (SED39136116-301)
3. USB 422 Assembly (SED39137921-301)
4. AMS-02 USB-422/PDIP Cable Assembly (SED39136111-301)
5. USB A/B Cable Assembly (SED39136130-801)

The AMS-02 RS422 T-0/PDIP cable will be used to patch RS422 signal from the payload to the Shuttle T0 umbilical for GSE monitoring and control prior to launch. The cable is connected between the Payload Data Interface Panel (PDIP) connectors J103 and J105. The cable is made of flight approved materials including nonflammable HR Plus Expando sleeving, Teflon-coated lacing cord, Scotch Weld 2216, P213 glass cloth tape, FEP Type C tape, Velcro fastener straps, Vibratite Formula 3, Teflon-insulated data bus cable, Twinax plug connector, and NLS plug connector. The use of Vibratite Formula 3 on non-structural, non-critical fasteners on soft-stowed hardware is acceptable.

The DDRS-02 Assembly will be used to patch RS422 signal from the payload to the NGLS A31P hard drive for data storage during on-orbit operations. It consists of one USB 422 unit connected to the USB A/B cable at one end and the USB-422/PDIP cable at the other end.

The USB 422 Assembly provides in-line conversion of RS422 synchronous serial signals to a USB 2.0 interface. The USB 422 unit consists of a single PCB housed in an anodized 6063-T6 enclosure with Twinax and USB type B connectors. The unit draws less than 0.5 amps and is powered by the NGLS USB 5.0 VDC source. The materials used in the USB 422 unit include RTV 3145 adhesive, RTV 3140 conformal coating, Kynar shrink tubing, Velcro fasteners, and Loctite 21463. The use of Loctite 21463 on non-critical fasteners of soft-stowed hardware is acceptable.

The USB-422/PDIP Cable Assembly is connected between the PDIP connector J105 and the USB 422 Assembly. The cable is made of flight approved materials including Teflon-insulated cable (M27500-22RE2S06), HR plus Expando sleeve, FEP Type C tape, P213 glass cloth tape, Vibratite Formula 3, and NLS plug connectors. The use of Vibratite Formula 3 on non-critical fasteners of soft-stowed hardware is acceptable.

The USB A/B Cable Assembly is connected between the USB 422 Assembly and NGLS. The cable is made of flight approved materials including the USB 2.0 cable wrapped with FEP Type C tape, P213 glass cloth tape, and Velcro fastener straps. No thread locking compound or adhesive is used in the USB A/B cable Assembly.

The AMS-02 data interface hardware will be soft stowed in crew cabin for launch and landing.

#### Stress Corrosion Cracking:

All metallic materials were evaluated for SCC and found acceptable.

#### General Corrosion:

All metallic materials were evaluated for corrosion and found acceptable.

#### Flammability:

All non-metallic materials are "A" rated for flammability or used in non-flammable configuration by analysis.

#### Toxicity:

All non-metallic materials are "A" rated or better for toxicity, or used in quantities below their maximum allowable limits for Shuttle and ISS per MAPTIS>

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**Aging:**

The AMS-02 data interface hardware was evaluated for aging and found acceptable. It is replaceable as needed.

**Microbiological Resistance:**

The AMS-02 data interface hardware was evaluated for microbiological resistance and found acceptable based on its accessibility for cleaning.

**Conclusion:**

There are no limitations on the use of the AMS-02 data interface hardware in Orbiter and ISS habitable areas.

MPE - C. Chang

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**ATTACHMENT 2**

**Attachment to MATL - 09-036**

AMS-02 RS422 T-0/PDIP Cable Assembly	SED39136112-302
DDRS-02 Assembly	SED39136116-301
USB422 Assembly	SED39137921-301
AMS-02 USB-422/PDIP Cable Assembly	SED39136111-301
USB A/B Cable Assembly	SED39136130-801